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Title: IQ and adolescent self-harm behaviours in the ALSPAC birth cohort

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Abstract

Background: Low IQ is associated with an increased risk of suicide and suicide attempt in adults, but less is known about the relationship between IQ and aspects of suicidal / self-harm behaviours in adolescence.

Methods: We used data from the Avon Longitudinal Study of Parents and Children (ALSPAC), a population-based prospective UK cohort. Binomial and multinomial logistic regression models were used to examine the association of IQ measured at age 8 with suicide-related outcomes amongst 4810 adolescents aged 16-17 years.

Results: There was some evidence that associations differed in boys and girls (p values for interaction ranged between 0.06 - 0.25). In boys higher IQ was associated with increased risk of suicidal thoughts (adjusted odds ratio per 10 point increase in IQ score = 1.14, 95% Confidence Interval [CI] 1.01-1.28) and suicidal plans (1.15, 95% CI 0.93-1.43), although statistical evidence for the latter association was limited. There was also evidence for an association with non-suicidal self-harm (1.24, 95% CI 1.08-1.45) but not suicidal self-harm (1.04, 95% CI 0.86-1.25). In girls higher IQ was associated with increased risk of non-suicidal self-harm (1.11, 95% CI 1.02-1.22) but not suicidal thoughts, suicidal plans or suicidal self-harm.

Conclusion: In contrast to previous studies of IQ-suicide associations in adults, we found that higher IQ was associated with an increased risk of non-suicidal self-harm

in male and female adolescents and suicidal thoughts in males. Associations of IQ with self-harm differed for self-harm with and without suicidal intent, suggesting that the aetiology of these behaviours may differ.

Keywords: suicidal thoughts, suicidal plans, self-harm, suicidal intent, IQ, ALSPAC

Introduction

Accumulating evidence suggests that lower IQ test score is associated with increased risk of suicide and suicide attempt (Allebeck et al., 1988; Andersson et al., 2008; Batty et al., 2009; Gravseth et al., 2010; Gunnell et al., 2005; O'Toole and Cantor, 1995; Sorberg et al., 2013). The observation may be due to the decreased ability to solve life problems among individuals of lower IQ. Additionally, lower intelligence may influence academic performance, leading to lower educational attainment, poor employment opportunities and financial difficulties; these are known risk factors for suicide. Furthermore, the observed association lower IQ may not be causally related to suicidal behaviour; it is possible that mental illness, a major risk factor of suicide, leads to impaired performance on tests of intellectual function, or that there are other common prior causes of suicide and low IQ (e.g. severe childhood adversities).

Most previous studies of IQ and suicide focus on mortality and use measures of IQ recorded in early adulthood. Furthermore, most studies have been based on military conscription data, so findings on the evidence to date are generally restricted to males; however, sex difference in the association of low IQ with suicide was shown in one recent study (Andersson et al., 2008). Studies assessing mortality generally found that low IQ is associated with an increased risk of suicide (Allebeck et al.,

1988; Andersson et al., 2008; Batty et al., 2009; Gravseth et al., 2010; Gunnell et al., 2005; O'Toole and Cantor, 1995). Few population-based studies have investigated the association of low IQ with other suicidal spectrum problems such as suicidal thoughts and non-fatal self-harm or used measures of IQ recorded in early childhood before the onset of many mental disorders. Furthermore, some studies have shown an inconsistent pattern of the relationship between low IQ and suicidal behaviours. One Australian cohort study reported that different aspects of IQ measured at age 14 had varying associations with suicide-related outcomes, including suicide attempts (Alati et al., 2009). Poor performance on test of non-verbal reasoning (Raven's standard progressive matrices), but not the Wide Range Achievements Test, was associated with an increased risk of these outcomes. In the New Zealand Dunedin cohort study the inverse relationship between IQ test score at age 8-9 and risk of attempted suicide diminished after controlling for childhood behavioural problems (Fergusson et al., 2005). A recent Swedish study showed that around 45% of the association between lower IQ and suicide / suicide attempt could be attributable to mental illness, aspects of personality and maladaptive behaviours, and social circumstances (Sorberg et al., 2013), indicating that psychological and social factors may lie on the causal pathway between IQ and suicidal behaviours. Data from a British cohort showed that IQ was

associated with recovery from rather than the occurrence of suicidal thoughts (Gunnell et al., 2009).

Overall, results from existing studies on the relationship between IQ test score and a wide range of suicidal behaviours are conflicting, and very few studies have used community samples of both males and females. Also, many previous studies assessed IQ in early adulthood; this may compromise the ability to infer a causal relationship between IQ and self-harm behaviours as performance on IQ tests might be influenced by pre-existing mental illness or the context (conscription medical examinations) in which the tests were carried out. Due to limitations in data availability, many previous studies focused on suicide or suicide attempts leading to hospital admission; cases who were not admitted or did not visit hospital were not included. Furthermore, a growing body of evidence indicates that although suicidal and non-suicidal self-harm behaviours frequently co-occur they may differ in several aspects, including behavioural motivation, frequency, lethality and expected behavioural functions (Hamza et al., 2012; Lloyd-Richardson et al., 2007). Individuals who engage in non-suicidal self-harm do not intend to end their lives - the most frequent motivations for such acts are to find relief from distressing affective states, to get control of a situation or to get a reaction from someone (Hamza et al., 2012; Lloyd-Richardson et al., 2007). Non-suicidal self-harm also tends to be a

frequently repeated behaviour and involve methods of low lethality (Hamza et al., 2012; Lloyd-Richardson et al., 2007). Exploring risk factors for a wide range of non-fatal self-harm behaviours is important not only because these spectrum behaviours are precursors of suicide, but also because they are in themselves major public health concerns, particularly in adolescents (Hawton et al., 2002; Kidger et al., 2012).

The aim of the current study is to explore the relationship between IQ test score and the risks of a wide range of suicidal behaviours, including suicidal thoughts, plans and self-harm behaviours with and without suicidal intent in adolescents.

Non-suicidal self-harm behaviour, commonly referred to as non-suicidal self-injury (NSSI) (Wilkinson and Goodyer, 2011), has been found to show some distinct characteristics compared to suicidal self-harm behaviour (Brausch and Gutierrez, 2010). The study utilizes data from the Avon Longitudinal Study of Parents and Children (ALSPAC), a large UK based birth cohort.

Methods

Sample

The Avon Longitudinal Study of Parents and Children (www.alspac.bris.ac) is a population-based prospective study of children born between 1 April 1991 and 31 December 1992 to mothers living in the former Avon health authority area (Boyd et

al., 2013). The former County of Avon includes both urban and rural areas and the population is broadly representative of children in the UK. The ALSPAC core sample consists of 14,541 pregnant women, who were invited to participate in a prospective study to collect a range of measures on socio-economic, environmental and health factors relating to themselves and their new born children (14,062 live births), from early pregnancy and at a number of follow-up points through childhood and adolescence. Participants have been followed up in research clinics, by questionnaire and through links to routine data since birth. The current study examined data obtained from 4810 participants who completed a self-harm questionnaire at age 16-17 years (Kidger et al., 2012). Please note that the study website contains details of all the data that is available through a fully searchable data dictionary (http://www.bristol.ac.uk/alspac/researchers/data-access/data-dictionary/). Ethical approval for the study was obtained from the ALSPAC Ethics and Law Committee and the Local Research Ethics Committees.

Measurements

At age 16-17, participants were sent a questionnaire which included detailed questions on suicidal thoughts and self-harm. The response rate and the estimated prevalence of self-harm have been reported previously (Kidger et al., 2012). Briefly, of the 9384 participants who received the questionnaire 4855 (51.7%) returned it and

4810 (51.3%) responded to the self-harm questions (Figure 1). Their mean age was 16 years 8 months (standard deviation [SD] = 2.9 months) at the time of completing the questionnaire. Those who returned the questionnaire were more likely to be female, have a mother in a non-manual social class, and to have relatively high educational qualifications (Kidger et al., 2012).

In the self-harm questionnaire participants were asked "have you ever hurt yourself on purpose in any way (e.g. by taking an overdose of pills or by cutting yourself)?" Positive responses to this question were used to indicate a history of self-harm. Participants who responded yes to either of the two questions below were classified as self-harm with suicidal intent: i) when being asked 'Do any of the following reasons help to explain why you hurt yourself on that occasion (i.e. the last time you hurt yourself on purpose)?' those who ticked the box 'I wanted to die' were classified as subjects with suicidal self-harm; ii) those who responded yes to "On any of the occasions when you have hurt yourself on purpose, have you ever seriously wanted to kill yourself?" were classified as subjects with suicidal self-harm. In the main analysis we treated those who responded yes to either question as suicidal self-harm. However, a previous study showed that a small number of subjects (n=50) who responded yes to the first suicidal intent question but no to the second question, suggesting that they may harm themselves in an attempt to express or relieve their

feelings of misery but not necessarily try to kill self (Kidger et al., 2012). Therefore in a sensitivity analysis we classified only those who responded yes to the second suicidal intent question as suicidal self-harm, as they explicitly expressed a wish to kill self. Participants were also asked whether they had ever thought of killing themselves, or made plans to kill themselves; answering 'yes' to the former was classified as having a history of suicidal thoughts and to the latter was classified as having a history of suicidal plans.

Participants' IQ was measured at age 8 years using the Wechsler Intelligence Scale for Children (WISC-III) (Wechsler et al., 1992). A short version of the test consisting of alternate items only (except the coding subset) was applied by trained psychologists. Verbal (information, similarities, arithmetic, vocabulary, comprehension) and performance (picture completion, coding, picture arrangement, block design, object assembly) subtests were administered, their scores scaled according to age, and the total IQ scores derived. For simplicity, throughout the paper 'IQ score' was used to indicate total IQ score.

Information on the following demographic and socioeconomic variables which may be potential confounders was obtained – mother's age at birth of the child (<25, 25-29, 30-34, 35+ years), housing tenure (mortgaged/owned versus other), mother's educational attainment (below O level, O level, above O level, where O ("Ordinary")

levels were key secondary school exams taken around the age of 16 until 1988 in the UK , and thus O level indicates secondary education qualification), and parental social class (the lowest class from maternal and paternal social class; manual versus non-manual). Information on two additional possible confounding factors was also extracted: i) depressive symptoms (measured by the self-reported Mood and Feelings questionnaire (Angold et al., 1995) completed at the same time as that for the self-harm questionnaire; subjects were categorised as depressed or not using the 10/11 point cut-off (Patton et al., 2008)) and ii) academic performance (children's scores in the national Standard Assessment Tests [SATs] at age 14 years; these tests are applied at school to all children in mainstream education in the UK). Data for these two additional factors were available only in a subset of participants.

Analytic strategies

Suicidal thoughts, suicidal plans, and self-harm at age 16-17 were modelled as outcome variables in logistic regression models to estimate odds ratios per 10 point increase in IQ score and their 95% confidence intervals. Multinomial logistic regression models were used when three possible outcomes for self-harm were considered: no self-harm (the baseline comparison group), self-harm with suicidal intent, and self-harm without suicidal intent; the difference between suicidal and non-suicidal self-harm in their associations with IQ was formally tested by specifying

non-suicidal self-harm as the baseline comparison group in the models. Differences in boys and girls were formally tested by including interaction terms (i.e. sex * IQ) in the models. We also examined non-linear associations by including quadratic terms of IQ in the models, as a previous study showed a U-shaped relationship between IQ and psychotic symptoms in adolescents (Horwood et al., 2008). The impact of potential confounding factors on the association was investigated by including these factors in the regression models. Associations with subsets of IQ, i.e. verbal IQ (VIQ) and performance IQ (PIQ), were also examined as previous research suggested different associations for different aspects of IQ (Alati et al., 2009).

The main analysis was based on the sample with complete information on self-harm, IQ, and potential confounders. Sensitivity analyses were conducted using imputed datasets to investigate the possible effect of missing data on our findings. Multivariate imputation by chained equations (MICE) was used to create multiple copies of datasets in which missing data were replaced by imputed values (Royston, 2005). These imputed values were sampled from their posterior predictive distributions obtained from prediction models that included variables related to missing data such as the socioeconomic position variables collected during pregnancy (Spratt et al., 2010). This imputation method is based on the Missing At Random (MAR) assumption, i.e. any systematic difference between the missing values and the

observed values can be explained by differences in other variables included in the imputation model. All variables used in the analyses (i.e. outcomes of interest, IQ and potential confounders) were also included in the imputation models. Missing data for the continuous measure of IQ were imputed using linear regression models and for other variables such as socio-demographics using binary or ordinal logistic models as appropriate. Twenty imputed datasets were generated, as a recent overview suggested that a larger number of imputed datasets (at least 20) may help with reducing sampling variability from the imputation process (Sterne et al., 2009). Imputation was conducted on the sample of 4810 participants who had information of self-harm but incomplete data for IQ and other potential confounders. The *ice* command in Stata (Royston, 2005) was used to conduct the multiple imputation. Results of analyses based on each dataset were combined using Rubin's rules (Little and Rubin, 2002) through the Stata command *mim*. All analyses in this study were conducted using Stata version 12 (StataCorp, College Station, TX, 2011).

Results

Amongst 4810 participants with available self-harm information 3823 (79.5%) had their IQ measured at age 8; 3560 (74.0%) of the 4810 subjects had information on all potential confounders, and the main analysis was based on this sample (Figure 1). 3486 (72.5%) and 2304 (47.9%) further had information on depression and SAT score

respectively. The proportions of males were similar in the samples with or without complete IQ and confounder information, but subjects with complete data were more likely to have a mother with above O level education and have parents from a non-manual social class (see Table 1 for more details). The lifetime prevalence of self-harm was 18.8% (95% Confidence Interval [CI] 17.7-19.9%) in the total sample (n=4810). In the sample with complete information of IQ and potential confounders (n=3560) the lifetime prevalence of self-harm was very similar (19.0%, 95% CI 17.7-20.2%); the prevalence was approximately 2.5 times higher in girls (25.4%, 95% CI 23.5-27.3%) than in boys (9.9%, 95% CI 8.4-11.5%). In boys, 3.4% (95% CI 2.5-4.3%) and 6.5% (95% CI 5.3-7.8%) had a history of suicidal and non-suicidal self-harm respectively; the corresponding figures in girls were 8.5% (95% CI 7.3-9.7%) and 16.9% (95% CI 15.3-18.5%).

Amongst the 3560 participants with complete data on IQ and potential confounders, the mean total IQ score at age 8 was 107.8 (SD = 16.1) (Table 2). Subjects with a history of non-suicidal self-harm tended to have higher IQ than those without a history of self-harm and those with suicidal self-harm (mean of total IQ score: 110.0 vs 107.6 vs 105.5 respectively). The pattern was similar in boys (113.8 vs 108.5 vs 109.3) and in girls (108.9 vs 106.8 vs 104.4) and for VIQ and PIQ (Table 2). Boys who ever thought about killing self tended to have higher IQ than those did

not (112.0 vs 108.6); this was not seen in girls (106.9 vs 107.0). A similar pattern was seen for suicidal plans (boys: 112.4 vs 108.8; girls: 106.5 vs 107.0).

Tables 3 and 4 show the associations of IQ with suicidal thoughts / suicidal plans and non-suicidal / suicidal self-harm respectively. In the total sample (boys and girls combined) with complete information on IQ and potential confounders, risk of non-suicidal self-harm increased 14% (95% CI 7-24%) per 10 point increase in IQ score in the adjusted models, whilst there was no statistical evidence for an association of IQ with suicidal thoughts, suicidal plans, or suicidal self-harm. There was some statistical evidence that associations of IQ with suicidal outcomes differed in males and females (p values for interaction = 0.06 for suicidal thoughts, 0.22 for suicidal plans, 0.15 for self-harm without suicidal intent, and 0.25 for self-harm with suicidal attempt in fully adjusted models), so all subsequent analyses are presented for boys and girls separately.

In the sample with complete information on IQ and potential confounders, there was evidence for an association of higher IQ scores with increased risk of suicidal thoughts for boys (Table 3); the model controlling for potential confounders showed that the risk of suicidal thoughts increased 14% per 10 point increase in IQ score (adjusted odds ratio [aOR] per 10 point increase in IQ = 1.14, 95% CI 1.01-1.28). In contrast there was no evidence for an association of IQ with suicidal thoughts in girls

(aOR = 1.02, 95% CI 0.98-1.09). Analyses of suicidal plans showed similar patterns; adjusted ORs were 1.15 (95% CI 0.93-1.43, p = 0.20) for boys and 0.98 (95% CI 0.86-1.12) for girls, although the OR estimate in boys was less precise (i.e. wider 95% CI) due to smaller numbers of subjects who reported suicidal plans (n=36) compared to suicidal thoughts (n=134) (Table 2). Results based on imputed datasets were similar, although the strength of associations in boys was somewhat weaker (Table 3). When additionally controlling for depression or academic performance (indicated by SAT scores) the pattern did not change (data not shown). Overall, analyses of VIQ and PIQ scores showed similar results (data not shown).

In the sample with complete information on IQ and potential confounders there was some evidence in boys that associations of IQ with self-harm differed depending on suicidal intent (p = 0.11) (Table 4); high IQ was associated with increased risk of non-suicidal self-harm (aOR = 1.24, 95% CI 1.08-1.45), but not suicidal self-harm (aOR = 1.04, 95% CI 0.86-1.25). Likewise, in girls there was evidence for a difference between non-suicidal and suicidal self-harm in their associations with IQ (p = 0.02); higher IQ was associated with the increased risk of non-suicidal self-harm but the risk was around half as much as that seen in boys (aOR = 1.11, 95% CI 1.02-1.22), whilst higher IQ was not associated with suicidal self-harm (aOR = 0.94, 95% CI 0.85-1.09).

Analyses of imputed datasets showed overall similar patterns (Table 4), although the strength of associations for non-suicidal self-harm attenuated somewhat (aORs = 1.18 [95% CI 1.03-1.35] for boys, 1.09 [95% CI 1.01-1.18] for girls). The pattern did not change after additionally controlling for depression or SAT scores (data not shown). Results for VIQ and PIQ were generally similar, except that there was no evidence for an association of PIQ with non-suicidal self-harm in girls (data not shown). There was no strong statistical evidence for quadratic relationships between IQ and suicidal thoughts, suicidal plans, or self-harm (all p values for quadratic terms in adjusted models > 0.10). When reclassifying the 50 subjects who wanted to die in the most recent self-harm episode but never seriously wanted to kill self as non-suicidal self-harm cases, the overall pattern remained unchanged (data not shown).

Discussion

Main findings

In contrast to findings reported in studies based on adults, we found an association of higher IQ with increased risk of non-suicidal self-harm in an adolescent sample. There was some evidence that associations differed in boys and girls. In boys, higher IQ was associated with increased risk of suicidal thoughts and non-suicidal self-harm, and there was also an indication of an increased risk of suicidal plans with

increasing IQ; in contrast there was no evidence for an association of IQ with suicidal self-harm. In girls higher IQ was associated with increased risk of non-suicidal self-harm but not suicidal thoughts, suicidal plans or suicidal self-harm. Results did not change after controlling for potential socio-economic confounders and were similar after additionally controlling for depression or academic performance. Sensitivity analyses in which missing data on IQ and other covariates were imputed also showed similar findings. Results for VIQ and PIQ were generally similar to those for full IQ.

Strengths and limitations

To the best of our knowledge, this is the first prospective investigation of the association of IQ with the incidence of a wide range of suicidal behaviours in youths. Our findings are based on data from adolescents living in the community and the sample size (N=4810) is larger than any other child or adolescent assessments to date. Validated instruments were used to measure IQ scores. A particular strength of our study was that we were able to differentiate self-harm with and without suicidal intent and found differences in these associations. Furthermore, the detailed demographic and socioeconomic data available for ALSPAC participants allowed us to control for a range of potential confounders. There are, however, a number of limitations to our analysis. First, loss to follow-up and questionnaire non-response may have led to

selection bias. As previously reported (Kidger et al., 2012), ALSPAC participants who did not receive the self-harm questionnaire were more likely to be male and non-white, to have poorer academic performance, and to have a mother in manual social class and with lower educational qualifications. Subjects who received but did not return the questionnaire differed from those who returned it in a similar way. However, imputation analysis indicated that these differences did not substantially influence the prevalence estimates of self-harm or risk factor profiles. Second, although self-report may encourage more honest responses to questions of self-harm or suicide than interviews (Safer, 1997), we relied on participants' own decision to define what constituted self-harm or suicidal intent. Third, it is possible that IQ may influence the likelihood of responding correctly to some sensitive questions – an issue that does not affect studies based on 'harder' endpoints such as suicide or hospital admission following self-harm.

Comparison with other studies

Although previous studies have consistently shown an inverse association between cognitive ability and suicide (Allebeck et al., 1988; Andersson et al., 2008; Batty et al., 2009; Gravseth et al., 2010; Gunnell et al., 2005; O'Toole and Cantor, 1995), findings of the relationship between IQ and suicidal behaviours not leading to death are inconsistent. Lower IQ was found to be a risk factor of suicide attempts

leading to hospital admission (Batty et al., 2010; Jiang et al., 1999; Osler et al., 2008; Sorberg et al., 2013); however, when suicidal thoughts / attempts have been investigated in community settings, their association with IQ has either been non-existent (Gunnell et al., 2009), explained away by other psychosocial variables (Fergusson et al., 2005), or only found in relation to certain tests of intelligence (Alati et al., 2009).

Our results seem to contradict previous studies indicating that higher IQ is associated with a decreased risk of suicide (Allebeck et al., 1988; Andersson et al., 2008; Batty et al., 2009; Gravseth et al., 2010; Gunnell et al., 2005; O'Toole and Cantor, 1995) and attempted suicide (Batty et al., 2010; Jiang et al., 1999; Osler et al., 2008) in adults. There are several possible explanations for these differences. First, the aetiology of suicidal or self-harm behaviours during adolescence may be different from that in adulthood. One previous study showed that high IQ was associated with increased risk of depressive symptoms during early adolescence (Glaser et al., 2011). Earlier psychological maturation for high IQ children during adolescence may lead to isolation from their same age peers. Gifted children's above-average abilities often make it difficult for them to share their interests and to interact with others reciprocally, causing problems in social and emotional development (Yun et al., 2011). As social acceptance is highly valued in adolescence, the loneliness and social

isolation experienced by high IQ children may result in elevated risk of depression, development of suicidal thoughts or expression of stress through self-harm behaviours (Brody and Benbow, 1986; Swiatek, 1995). It is also possible that higher IQ children are more thoughtful and more prone to existential angst when they go through the teenage years, and therefore they are more likely to have suicidal thoughts, come up with suicidal plans or regulate their distress through self-harm behaviours. Second, it is possible that IQ may have different influences on different self-harm spectrum behaviours. Non-suicidal self-harm may be conceived as a coping mechanism to regulate stress, whereas suicidal self-harm indicates a desire to end one's life (Muehlenkamp and Gutierrez, 2004; Wichstrom, 2009). The findings that higher IQ was associated with non-suicidal self-harm but not suicidal self-harm suggest that self-harm behaviours in talented children are to find relief from distressing conditions, rather than a desire to end their life. Third, the results could be due to differential reporting bias according to cognitive ability. Since the self-harm measure was based on self-report, it is possible that children with higher IQ were better able to recognize their problems and report them. Lastly it is possible that this is a chance finding, and it requires replication in other community-based cohorts.

Our data showed that the association of higher IQ with risk of non-suicidal self-harm was stronger in boys than in girls. Such differences are in keeping with those seen at age 17 in relation to IQ and depression in ALSPAC (Glaser et al., 2011) and may reflect differences in the timing of puberty / emotional maturation in males and females – males mature later than females. Alternatively this finding may reflect sex differences in perceived life satisfaction as well as peer pressure experienced by children with higher cognitive abilities (Rose and Rudolph, 2006). The observed sex pattern could also be due to sex differences in self-harm behaviours; whereas girls across all ranges of cognitive ability may use self-harm as a coping strategy, boys of different levels of IQ may adopt different strategies. For example, boys with higher IQ may be more likely to cope by using non-suicidal self-harm whereas boys with low IQ may be more likely to engage in conduct disorders or delinquency (Eme, 2007). Our finding highlights the importance of identifying different behavioural patterns in adolescent boys with different levels of cognitive capacity, as they may have different behavioural signs of psychological problems.

It should be noted that our study was based on a UK cohort; different cultures may have different social views, norms and attitudes towards high IQ children, and hence may have affected the relationship between IQ and suicidal behaviours. For example, in East Asia, educational achievement is highly emphasized, and better

academic performance in high IQ children usually lead to a higher level of approval and respect among their peers (Leung, 2001). This is different from the Western context where academic achievement may not be so highly valued. The generalizability of our research findings to other socio-cultural contexts needs further replication.

Implications

The differences in relationship of IQ with self-harm behaviours between those with and without suicidal intent suggest these two forms of self-harm behaviours may not represent a continuum of behavioural severity. It may be important to make distinction between these two overlapping phenomenon in order to inform better prevention and treatment efforts (Wilkinson and Goodyer, 2011). Self-harm behaviours, stereotypically, are often regarded as feminine behaviours, and the contributing factors and mechanisms underlying self-harm in boys are not well-researched. The finding that boys with higher IQ were particularly at risk of non-suicidal self-harm speaks to the need of exploring the emotional expression patterns and mental health need amongst adolescent boys across different levels of cognitive abilities.

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Tables

Table 1. Comparison of participants with and without complete information on IQ and potential confounders by key background variables.

		Participants without complete information on IQ and potential confounders (N=1250)		Participants with complete information on IQ and potential confounders (N=3560)				
		n	(%)	n	(%)	χ^2	df	p
Sex	Males	491	(39.3)	1,481	(41.6)	2.1	1	0.15
	Females	759	(60.7)	2,079	(58.4)			
Mother's highest educational qualification*	Below O level	317	(28.2)	557	(15.7)	116.9	2	<0.001
	O level	397	(35.4)	1,156	(32.5)			
	Above O level	409	(36.4)	1,847	(51.9)			
Parental social class (the lowest from maternal and paternal social class)	Manual	495	(53.2)	2,270	(63.8)	34.6	1	<0.001
	Non-manual	435	(46.8)	1,290	(36.2)			

*O level indicates secondary education qualification.

Table 2. IQ score by history of self-harm, suicidal thought and suicidal plan.

	Total Sample	Self-harm history			Ever had suicidal thoughts		Ever had suicidal plans	
		No self-harm	Suicidal self-harm	Non-suicidal self-harm	No	Yes	No	Yes
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Boys and girls	n=3,560	n=2,885	n=227	n=448	n=3,010	n=550	n=3,420	n=140
Total IQ	107.8 (16.1)	107.6 (16.2)	105.5 (16.5)	110.0 (15.0)	107.7 (16.1)	108.1 (16.2)	107.7 (16.1)	108.1 (16.5)
VIQ	110.4 (16.4)	110.3 (16.6)	107.8 (16.4)	112.4 (15.4)	110.3 (16.4)	110.5 (16.5)	110.4 (16.4)	110.6 (16.6)
PIQ	102.8 (16.8)	102.6 (16.8)	101.7 (18.0)	104.9 (16.1)	102.7 (16.7)	103.5 (17.4)	102.8 (16.7)	103.4 (17.7)
Boys	n=1,481	n=1,334	n=50	n=97	n=1,347	n=134	n=1,445	n=36
Total IQ	108.9 (16.7)	108.5 (16.7)	109.3 (16.0)	113.8 (16.4)	108.6 (16.8)	112.0 (15.8)	108.8 (16.8)	112.4 (15.7)
VIQ	112.1 (17.2)	111.8 (17.3)	110.9 (17.0)	116.7 (15.6)	111.8 (17.3)	114.7 (16.5)	112.0 (17.2)	116.3 (16.3)
PIQ	103.0 (17.5)	102.6 (17.3)	105.2 (19.3)	107.4 (18.6)	102.7 (17.4)	106.0 (18.3)	102.9 (17.5)	104.9 (19.1)
Girls	n=2,079	n=1,551	n=177	n=351	n=1,663	n=416	n=1,975	n=104
Total IQ	106.9 (15.6)	106.8 (15.6)	104.4 (16.6)	108.9 (14.4)	107.0 (15.4)	106.9 (16.2)	107.0 (15.5)	106.5 (16.6)
VIQ	109.1 (15.8)	108.9 (15.8)	106.9 (16.2)	111.2 (15.2)	109.1 (15.6)	109.2 (16.3)	109.2 (15.7)	108.6 (16.4)
PIQ	102.7 (16.3)	102.6 (16.3)	100.7 (17.6)	104.2 (15.2)	102.7 (16.1)	102.7 (17.1)	102.7 (16.2)	102.8 (17.2)

Abbreviations: SD = standard deviation; VIQ = verbal IQ; PIQ = performance IQ.

Table 3. Logistic regression models of the association of IQ score with suicidal thoughts and plans in 16-17 year old boys and girls in the ALSPAC cohort

	Complete case analysis (1481 boys and 2079 girls)		Imputed data analysis (1972 boys and 2838 girls)	
	Unadjusted odds ratio (95%CI)	Adjusted odds ratio (95%CI)*	Unadjusted odds ratio (95%CI)	Adjusted odds ratio (95%CI)*
Boys and girls				
per 10 point increase in IQ score				
Suicidal thoughts	1.02 (0.96, 1.08)	1.05 (0.99, 1.12)	1.01 (0.96, 1.07)	1.04 (0.98, 1.11)
Suicidal plans	1.01 (0.91, 1.12)	1.03 (0.92, 1.16)	0.99 (0.90, 1.10)	1.03 (0.92, 1.15)
Boys				
per 10 point increase in IQ score				
Suicidal thoughts	1.13 (1.02, 1.26)	1.14 (1.01, 1.28)	1.11 (1.00, 1.23)	1.11 (0.99, 1.23)
Suicidal plans	1.14 (0.93, 1.40)	1.15 (0.93, 1.43)	1.09 (0.90, 1.32)	1.11 (0.91, 1.36)
Girls				
per 10 point increase in IQ score				
Suicidal thoughts	1.00 (0.93, 1.07)	1.02 (0.94, 1.09)	1.00 (0.93, 1.07)	1.02 (0.94, 1.09)
Suicidal plans	0.98 (0.87, 1.12)	0.98 (0.86, 1.12)	0.98 (0.86, 1.11)	1.00 (0.88, 1.15)

*Adjusted for maternal age at birth, housing tenure, parental social class, mother's education.

Table 4. Multinomial logistic regression models of the association of IQ score with self-harm with and without suicidal intent in 16-17 year old boys and girls in the ALSPAC cohort

	Complete case analysis (1481 boys and 2079 girls)		Imputed data analysis (1972 boys and 2838 girls)	
	Unadjusted odds ratio (95%CI)	Adjusted odds ratio (95%CI)*	Unadjusted odds ratio (95%CI)	Adjusted odds ratio (95%CI)*
Boys and girls				
per 10 point increase in IQ score				
Non-suicidal self-harm versus no self-harm	1.10 (1.03, 1.17)	1.14 (1.07, 1.24)	1.08 (1.02, 1.15)	1.11 (1.04, 1.19)
Suicidal self-harm versus no self-harm	0.92 (0.85, 1.00)	0.97 (0.88, 1.09)	0.94 (0.87, 1.01)	0.99 (0.91, 1.07)
Boys				
per 10 point increase in IQ score				
Non-suicidal self-harm versus no self-harm	1.22 (1.07, 1.39)	1.24 (1.08, 1.45)	1.18 (1.03, 1.34)	1.18 (1.03, 1.35)
Suicidal self-harm versus no self-harm	1.03 (0.87, 1.22)	1.04 (0.86, 1.25)	1.03 (0.87, 1.21)	1.03 (0.86, 1.23)
Girls				
per 10 point increase in IQ score				
Non-suicidal self-harm versus no self-harm	1.09 (1.01, 1.18)	1.11 (1.02, 1.22)	1.08 (1.01, 1.16)	1.09 (1.01, 1.18)
Suicidal self-harm versus no self-harm	0.91 (0.82, 1.00)	0.94 (0.85, 1.09)	0.93 (0.85, 1.02)	0.97 (0.88, 1.07)

*Adjusted for maternal age at birth, housing tenure, parental social class, mother's education.